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वस्त्रादि — जल अवरोधक परत चढ़ा उच्च घनत्व पालीइथाइलीन (एच.डी.पी.ई.) का बुना हुआ कपड़ा (भू-मेम्बरेन) — विशिष्टि

(पहला पुनरीक्षण)

Indian Standard

TEXTILES — LAMINATED HIGH DENSITY POLYETHYLENE (HDPE) WOVEN FABRIC (GEO-MEMBRANE) FOR WATER PROOF LINING — SPECIFICATION

(First Revision)

ICS 59.060.20; 93:160

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 5

Textile Materials Made from Polyolefins Sectional Committee, TXD 23

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Textile Materials Made from Polyolefins Sectional Committee had been approved by the Textile Division Council.

Laminated high density polyethylene woven fabric, so called geo-membranes, are very low permeability synthetic liners used to control fluid or gas migration within soil, rock, earth or any other geo-technical material, as integral part of a man-made product, structure or system. As a synthetic component used within the ground, they are technically geo-synthetic, the prefix 'geo' indicating usage on or in the earth. The other primary geo-synthetics are geo-textiles, geo-nets, geo-grids, geo-composites and geo-composite clay liners.

The original use of geo-membranes was for the distribution, storage and containment of potable agricultural water supplies. It still remains as an important element of this market, except now it has been broadened to contain a wide variety of liquids.

Geo-membranes have become the design choice as part of a cover system due to a variety of factors such as imperviousness, chemical resistance, inertness to surrounding soils, ease and variety of seaming, mechanical strength and elongation, ease of application and economics, product durability and ageing over the designed life of the containment system.

The composition of the Committee responsible for the formulation of this standard is given in Annex F.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2:1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

TEXTILES — LAMINATED HIGH DENSITY POLYETHYLENE (HDPE) WOVEN FABRIC (GEO-MEMBRANE) FOR WATER PROOF LINING — SPECIFICATION

(First Revision)

1 SCOPE

This standard prescribes requirements for high density polyethylene (HDPE) woven fabric (geo-membrane) laminated with low density polyethylene (LDPE) or suitable combination of LDPE and LLDPE for use as lining for canal, pond and reservoir to control seepage and for proper disposal of industrial effluents, etc. However, the material is not suitable for lining of roof/terrace.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 MANUFACTURE

3.1 The laminated HDPE woven fabric (geo-membrane) shall be manufactured from HDPE fabric (*see* IS 6899) to meet the final requirements of mass (g/m^2) as per Table 1. The width of the tape used in the fabric shall be minimum 1.20 mm and linear density of the tape shall be minimum 88.8 Tex (800 Denier). The fabric shall have a minimum of 39 tapes/dm in warp and weft. The tape shall be manufactured from HDPE granules which shall be UV stabilized by adding suitable UV stabilizer or carbon black and the finished laminated fabric shall meet the requirements of UV stability as given in Table 1. In case the waterproof lining is to be used for drinking water, the tape and the films used for lamination shall be of food grade quality (*see* IS 10146).

3.2 The lamination of the fabric shall be done on both sides with low-density polyethylene film (LDPE) or with suitable combination of LDPE and linear low density polyethylene (LLDPE). The coating thickness shall be as agreed to between the buyer and the seller subject to a minimum of 25 micron. The film shall be stabilized by incorporating minimum 2.5 percent of carbon black in the granules (*see* IS 2530) with satisfactory dispersion. For sandwich lamination, the coating thickness shall be as agreed to between the buyer and the seller subject to a minimum of 35 microns.

3.2.1 If two or more layers of HDPE fabric are used, these shall be joined by sandwich lamination. The lamination as given above shall also be such that the finished material meets the requirements given in Table 1.

3.3 Joints/Seams

If two or more pieces of fabrics are used, the fabric shall be joined/seamed together by a suitable heat sealing process keeping an overlap of at least 2.5 cm.

4 TYPES

Based on the thickness and mass in g/m^2 of waterproof woven fabric, the material is classified as follows:

a) *Type I* — having thickness of 0.25 mm and mass of 250 g/m^2, *Min*;
b) *Type II* — having thickness of 0.50 mm and mass of 420 g/m^2, *Min*;
c) *Type III* — having thickness of 0.75 mm and mass of 650 g/m^2, *Min*; and
d) *Type IV* — having thickness of 1.00 mm and mass of 950 g/m^2, *Min*.

5 REQUIREMENTS

5.1 Manufacture

The fabric shall be uniform in colour, texture and finish. It shall be free from pin holes, undispersed raw material, particles of foreign matter, etc, and the laminated film shall not peel off from the fabric. The minimum width of the fabric panel shall be 1 800 mm. A combination of panel width may be used to obtain desired width of liner. Narrow width panels not less than 900 mm in width may also be used but such pieces shall not exceed 1 piece per roll of finished material of specified width.

5.2 The laminated HDPE fabric shall also conform to the requirements given in Table 1.

6 PACKING AND MARKING

6.1 Packing

The laminated woven fabric shall be packed in roll form in length of 500 m or as agreed to between the buyer and the seller. The rolls shall be packed by HDPE fabric laminated on both sides with LDPE or of the same construction and specifications as that of the rolls.

6.2 Marking

6.2.1 The fabric roll shall be marked legibly with the following information:

a) Indication of the source of manufacture;
b) Type of fabric (geo-membrane);
c) Declared length and width of the fabric;
d) Mass per square metre of the fabric;
e) Batch No. and date of manufacture; and
f) Any other information desired by the buyer.

6.2.2 *BIS Certification Marking*

The fabric roll may also be marked with the Standard Mark.

6.2.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and Rules and Regulations made thereunder. The details of conditions under which the license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7 SAMPLING

7.1 Lot

All fabric rolls of same construction and type dispatched to a buyer against one dispatch note shall constitute a lot.

7.2 The number of fabric rolls to be selected from a lot shall be as given in Table 2.

7.3 The conformity of the lot to the requirements of this standard shall be determined on the basis of the tests carried out on the samples selected from it.

8 NUMBER OF TEST SPECIMENS AND CRITERIA FOR CONFORMITY

The laminated woven fabric from each roll selected from the lot shall be tested for various requirements given in Table 1 of this standard. Any fabric roll failing to meet one or more of the corresponding requirements prescribed in **5.1, 5.2** and Table 1 shall be considered as defective. The lot shall be accepted, if no defective roll is found.

Table 1 Requirement for Laminated HDPE Woven Fabric (Geo-Membrane) for Water Proof Lining

(*Clauses* 3.1, 3.2.1 *and* 5.2)

Sl No.	Property	Requirement				Method of Test, Ref to
		Type I	Type II	Type III	Type IV	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Thickness, mm, *Min*	0.25	0.50	0.75	1.00	IS 7016 (Part 1)
ii)	Mass, g/m², *Min*	250	420	650	950	IS 7016 (Part 1)
iii)	Dimensions (length and width)	As declared + 1 percent with no negative tolerance				Annex A of IS 11652
iv)	Carbon black content, percent, *Min*	2.5				IS 2530
v)	Breaking load on 20 cm × 10 cm strip, N, *Min* before UV exposure	2 000	3 500	4 500	6 500	IS 13162 (Part 5)
vi)	Strain at maximum load, percent	20 ± 5	20 ± 5	20 ± 5	20 ± 5	IS 13162 (Part 5)
vii)	Breaking load on 20 cm × 10 cm strip, N, *Min* after UV exposure of 500 h	85 percent of actual original value				IS 13162 (Parts 2 and 5)
viii)	Impact failure load, at 1 520 mm drop, *Min*, gram force at 50 percent failure	1 000	1 600	2 500	3 500	Annex B
ix)	Tear resistance, N, *Min*	70	120	150	180	Annex C
x)	Puncture resistance, N, *Min*	250	400	725	900	Annex D
xi)	Bursting strength (ball burst), N/cm², *Min*	45	85	110	160	IS 7016 (Part 6)
xii)	Seam strength before UV exposure, N/mm, *Min*	11	24	40	42	IS 15060
xiii)	Hydrostatic resistance	No leakage at 10 kg/cm²	No leakage at 15 kg/cm²	No leakage at 20 kg/cm²	No leakage at 25 kg/cm²	Annex E

NOTE — For hydrostatic resistance test, the test specimen shall be selected such that at least one joint is covered, if provided.

Table 2 Scale of Sampling and Criteria for Conformity

(*Clause* 7.2)

Sl No. (1)	No. of Fabric Rolls in the Lot (2)	No. of Fabric Rolls to be Selected (3)	Permissible No. of Defectives (4)
i)	Up to 50	5	0
ii)	51-100	8	0
iii)	101-300	13	0
iv)	301 and above	20	0

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
2530 : 1963	Methods of test for polyethylene moulding materials and polyethylene compounds
6899 : 1997	Textiles — High density polyethylene (HDPE) woven fabrics — Specification (*second revision*)
7016	Methods of test for coated and treated fabrics:
(Part 1) : 1982	Determination of roll characteristics (*first revision*)
(Part 6) : 1984	Determination of bursting strength (*first revision*)
10146 : 1982	Specification for polyethylene for its safe use in contact with foodstuffs, pharmaceuticals and drinking water
11652 : 2000	Textiles — Woven sacks for packing cement — High density polyethylene (HDPE)/Polypropylene(PP) — Specification (*second revision*):
13162	Geo-textiles — Methods of test
(Part 2) : 1991	Determination of resistance to exposure of ultra-violet light and water (Xenon arc type apparatus)
(Part 5) : 1992	Determination of tensile properties using a wide width strip
15060 : 2001	Geo-textiles — Tensile test for joint/ seams by wide width method

ANNEX B

[*Table* 1, *Sl No.* (viii)]

DETERMINATION OF IMPACT RESISTANCE

B-1 TERMINOLOGY

B-1.1 Impact Failure Load — The load at which 50 percent of the specimens fail when tested by this method.

B-2 ANNULAR SPECIMEN CLAMP

B-2.1 Two Piece Annular Specimen Clamp, having an inside diameter of 12.7 cm and conforming to the following requirements:

a) The lower or stationary half of the clamp shall be rigidly mounted so that the plan of the specimen is horizontal and at an angle of 90° with respect to the upright shaft-supporting member of the apparatus.

b) The upper or movable portion of the clamp shall be designed to maintain positive and planer contact with the lower portion of the clamp when in position. This portion of the clamp shall be provided with suitable means for maintaining sufficient contact with the lower clamp to hold the specimens firmly in place during the test.

c) Gasketing materials prepared from rubber or similar material shall be affixed to the specimen contact surfaces of both clamps. This provides a cushion which minimizes thickness variation effects and also allows firm gripping of the specimen and minimizes slippage.

B-2.2 Adapter — An electromechanical (pneumatic) or similar suitable device for use in supporting and instantaneously releasing the dart so that it will fall freely on to the centre of test specimen in the specimen holder.

B-2.3 Dart — Consisting of a 3.81 cm diameter hemispherical head fitted with 0.64 cm diameter shaft 11.5 cm long, to accommodate removable mass. The head shall be constructed of aluminium, phenolic plastic or other low density material of similar hardness. The shaft shall be attached to the centre of the flat upper surface of the head with its longitudinal axis at 90° to the surface. The shaft shall be made of aluminium with a 1.27 cm long steel tip (tip with suitable material) at the end for supporting it in the adapter.

B-2.4 Masses — Stainless steel detachable masses as follows:

One mass of 3 000 ± 5 g, two masses of 1 000 ± 5 g each, two masses of 500 ± 2g each, two masses of 300 ± 2g each, two masses of 200 ± 2g each and two masses of 100 ± 2g each having approximate dimensions of 8 to 10 cm in diameter and approximately 1 cm thickness with a hole in the centre of minimum 0.65 cm in diameter.

NOTE — Additional masses may be constructed for use, if it is necessary to extend mass beyond that attainable when using all the masses in the set suggested above.

B-2.5 Positioning Device — Means shall be provided for positioning the dart at the following drop heights from the impinging surface of the dart head to the surface of the test specimen:

Positioning	*Drop Height* mm
Normal impact resistant fabric	660
High impact resistant fabric	1 524

B-2.6 Cushioning and Shielding Devices — To protect personnel and to avoid damaging of the impinging surface of the dart.

B-3 TEST SPECIMENS

Test specimens shall be large enough to extend outside the specimen clamp gaskets at all points. The specimens shall be representative of the material under test and shall be free from pinholes, wrinkles, folds or other obvious imperfections, unless such imperfections constitute variables under test.

B-4 PROCEDURE

B-4.1 Place the specimen over the bottom portion of the clamp, making certain that it is uniformly flat, free of folds and that it covers the gasket at all points. Clamp the specimen in place of applying annular pressure with the top portion of the clamp. Position the dart vertically with the steel shaft tip inserted in the adapter and the impinging surface of the dart at the appropriate height from the fabric surface. Release the dart. Take care to avoid multiple impacts in cases where the dart bounces off the specimen. Attempt to catch the dart in such cases to prevent damage to the impinging surface.

B-4.2 Observe the failure as any break through the fabric readily by viewing the specimen under back lighting conditions and examine the specimen to determine whether it has failed or not. Use a new specimen for each impact.

B-4.3 Before beginning the test, make a few trial runs to establish approximately the working range of masses which will break the fabric. Then for at least 3 dart masses selected to give percentage failure between 20 and 80, a minimum of 10 test specimens at each dart mass shall be tested.

B-5 DETERMINATION OF IMPACT FAILURE LOAD

B-5.1 Plot the percentage of failures against total mass of the dart on a graph paper and determine the results graphically. Read the value of impact failure load from the graph as the dart mass at which 50 percent of the specimens fail.

B-5.2 Clamp a test specimen without tension between circular plates of a ring clamp attachment secured in a tensile testing machine. A force is exerted against the centre of the unsupported portion of the test specimen by a solid steel rod attached to the load indicator until rupture of the specimen occurs. The maximum force recorded is the value of the puncture resistance of the specimen.

B-5.3 The test requires a ring clamp attachment consisting of concentric plates with an open internal diameter of 44 mm, capable of clamping the test specimen without slippage. A solid steel rod is used as the puncture probe, having diameter of 10 mm and a flat chamfered edge with 45°.

B-5.4 Fifteen specimens are cut from the sample material, spaced along a diagonal and representing the entire roll width exclusive of selvage. Minimum specimen diameter is 100 mm.

B-5.5 The specified rate of crosshead travel is 300 mm/mm. To perform the test, the puncture probe is attached to the moving crosshead and brought against the clamped specimen until rupture occurs. The puncture resistance result is the maximum load obtained.

B-5.6 The mean puncture resistance (maximum load) as calculated from the 15 specimens is reported.

ANNEX C

[*Table* 1, *Sl No.* (ix)]

DETERMINATION OF TEAR RESISTANCE

C-1 SCOPE

The tearing strength of the laminated HDPE woven fabric (geo-membrane) shall be determined by the pendulum method.

C-2 TESTING MACHINE

C-2.1 Falling Pendulum (Elmendorf) Type Tester — Wherein the specimen is held between a pair of clamps, one movable and the other stationary, and torn by the fall of a pendulum through the force of gravity. The machine shall consist of the following:

C-2.1.1 *Pendulum*

Carrying a circumferential graduated scale so as to indicate the force used in tearing the specimen.

C-2.1.2 *Movable Clamp*

Carried on a pendulum, preferably formed by a sector of a wheel or circle free to swing on a ball or other substantially frictionless bearing, and a stationary clamp. The gripping surface of the jaws in each clamp shall be not less than 25 mm wide and 16.5 mm deep. The clamps shall be separated by a distance of 2.5 mm.

C-2.1.3 *Pointer and Pointer Stop*

To record the maximum arc of swing of the sector pendulum.

C-2.1.4 *Sector Release*

To hold the pendulum in a raised position during the mounting of the specimen and to permit it to fall through the force of gravity.

C-2.1.5 *Knife Attachment*

For initial slitting of the specimen.

C-3 ADJUSTMENT OF APPARATUS

C-3.1 Level the instrument so that, with the sector free, the line on the sector indicating the vertical from the point of suspension coincides with a corresponding point on the base of the instrument, usually placed on the stop mechanism. For apparatus having a sector as a pendulum, and which tears the specimen as it moves toward the right, draw a pencil line on the base of stop mechanism 25 mm to the right of the edge of the sector stop. With the sector raised to its initial position and the pointer set against its stop, on releasing the sector and holding the stop down, the sector should make at least 20 complete oscillations before the edge of the sector that engages with the stop no longer passes to the left of the pencil line. Otherwise, the bearing shall be oiled and adjusted.

C-3.2 After levelling, operate the instrument several times with nothing in the jaws, and movable jaw being closed, to ascertain if the pointer registers zero with no load. If zero is not registered, the pointer stop should be suitably adjusted until the zero reading is obtained. If it is necessary to move the pointer stop, the pointer friction should be checked as in **C-3.3.**

C-3.3 Set the pointer at the zero reading on the scale before releasing the sector and after release see that the pointer is not pushed more than three scale divisions beyond the zero. A reading of more than three divisions indicates excessive pointer friction and the pointer should be removed, the bearing wiped clean, and a trace of light instrument oil applied. When the pointer friction has been reduced, finally adjust the point stop.

C-3.4 Calibration of Apparatus

C-3.4.1 Level and adjust the instrument on a smooth, flat surface and clamp a known mass in grams, W, to the radial edge of the sector beneath the jaws. The centre of gravity of the mass (including means of attaching) shall be previously marked by a punched dot on the face of the mass that is to be in the front of the instrument.

C-3.4.2 Raise and set the sector as for tearing a specimen and, by means of a surface gage or other convenient means, measure the height, H, of the centre of gravity of the mass above the glass plate. Then release the sector, allow it to swing, and note the pointer reading. Without touching the pointer, raise the sector until the edge of the pointer just meets with its stop, in which position again determine the height in centimetres, h, of the centre of gravity of the mass above the glass plate.

C-3.4.3 The work done is $W(H-h)$ g-cm. The pointer reading for the standard instrument and test method specified should be as follows:

$$W(H-h)/137.6$$

C-3.4.4 Five forces from 75 to 400 g form a suitable range for the calibration, one or more being clamped on the edge of the sector in different positions, the work done in raising each being calculated and added together.

C-3.4.5 Make a record of deviations of the indicated readings and make corresponding corrections in the test results.

C-3.4.6 The instrument should be periodically calibrated. Alternate and more rapid calibration procedures, recommended by the manufacture of the apparatus, using so-called check weights, are also acceptable.

C-3.4.7 The tearing distance, which equals 43 mm, shall be checked prior to each series of tests.

C-4 TEST SPECIMEN

The standard test specimen shall be a rectangle of laminated fabric cloth approximately 100 mm long and exactly 63 mm wide, with the slit to be cut 20 mm, thus leaving a distance of exactly 43 mm between the end of slit and the edge of the specimen. A blade height setting gage, available from the equipment supplier, should be used to verify the slit length.

C-5 PROCEDURE

C-5.1 Place the specimen securely in the clamp. Locate the knife attachment so as to slit the specimen midway between the clamps at right angles to the upper edge of the clamps. Make a slit extending from the bottom edge of the specimen to a point 4 mm above the top edge of the clamps leaving a distance of 43 mm of uncut specimen perpendicular to the long dimension of the specimen. The accuracy of the readings obtained with the apparatus depends to a great extent on the exactness of this 43 mm of uncut specimen.

C-5.2 With pendulum in the raised position the moveable clamps shall lie in the same plane as the fixed clamp forming an extension to the fixed clamp. This plane shall be perpendicular to the plane of oscillation of the pendulum.

C-5.3 The perpendicular from the line formed by the top edge of the clamps to the axis of suspension shall be 104 mm shall make an angle of 27.5° with the plane of the specimen.

C-5.4 Press the sector release, causing the sector to fall, thus moving the pendulum clamp away from the fixed clamp so as to tear the specimen. Read from the scale, to the nearest division, the force required to tear the specimen.

C-5.5 Reject readings obtained where the tear deviates more than 10 mm away from the initial slit. Likewise, if the side of the specimen above the movable jaw rubs against the sector as the tear is made, reject the reading.

C-5.6 The machine, when used for a given specimen shall be of such capacity that the maximum forced required to tear the specimen is not greater than 85 percent or less than 15 percent of the rate capacity.

C-5.7 Make not less than five tests in each principal direction of the laminated woven fabric.

C-5.8 Calculation and Report

C-5.8.1 Report the results as the force in Newton required to tear a specimen.

C-5.8.2 Report the average, maximum and minimum results for both principal directions of the laminated fabric.

ANNEX D

[*Table* 1, *Sl No.* (x)]

DETERMINATION OF PUNCTURE RESISTANCE

D-1 PRINCIPLE

A test specimen is clamped without tension between circular plates of a ring clamp attachment secured in a tensile testing machine and a force is exerted against the centre of the unsupported portion of the test specimen by a piercing instrument attached to the load indicator until rupture of the specimen occurs. The maximum force recorded is the value of the puncture resistance of the specimen.

D-2 TENSILE TESTING MACHINE

The tensile testing machine with a constant rate of extension of 5 ± 0.2 mm/s shall be equipped with a bursting attachment of such design that the specimen is held securely by a ring clamp mechanism until a rupture of the specimen is produced. The ring clamp mechanism shall consist of concentric plates with an open internal dia of 44.0 ± 0.05 mm capable of clamping the test specimen without slippage and with the centre of the specimen pressed against a piercing instrument shaped like a flared, flat-tip screwdriver, having a width of 7.92 ± 0.25 mm and a thickness of 0.8 ± 0.1 mm at the extreme tip. The piercing tip edges shall be rounded to a 0.25 mm radius. The piercing instrument shall be oriented to intercept the warp and weft threads of the mounted specimen at an angle of approximately 45°. If the machine is of pendulum type, it shall be of such capacity that the maximum load required to burst the specimen shall be not greater than 85 percent or less than 15 percent of the rated capacity.

D-3 TEST SPECIMENS

Five circular specimens shall be cut, each having a diameter of at least 12.5 mm greater than the outside diameter of the ring-clamp mechanism of the testing machine.

D-4 PROCEDURE

Mount each specimen, centering it in the ring clamp. Allow the piercing device to descend at a rate of 300 mm/min until puncture of the laminated fabric occurs. Record the force required to completely penetrate the specimen.

D-5 CALCULATION

The average puncture resistance of the material shall be the arithmetic mean of the results of five tests as reported in Newton.

ANNEX E

[*Table* 1, *Sl No.*(xiii)]

DETERMINATION OF HYDROSTATIC RESISTANCE OF LAMINATED HDPE WOVEN FABRIC (GEO-MEMBRANE) FOR WATERPROOF LINING

E-1 GENERAL

The hydrostatic resistance of a laminated woven fabric shall be determined by a Mullen-type hydrostatic tester.

E-2 TESTING MACHINE

The testing machine may be either mechanically or manually operated. It shall permit the clamping of the material to be tested between two circular clamps about 75 mm in diameter having a coaxial apparatus of their centres 31.2 ± 0.5 mm in diameter. The surface of the clamps between which the specimen is to be placed shall be concentrically grooved. The grooves shall be spaced 0.8 mm apart and of a depth not less than 0.15 mm. The grooves shall not start closer than 3.18 mm from the edge of the aperture. The lower clamping surface shall have a recession concentric to the aperture capable of accepting and O-ring having a cross-sectional diameter of 4.7 ± 0.01 mm. The machine shall have means of applying hydraulic pressure to the underside of the clamp specimen until the specimen fails. The pressure shall be generated by means of a piston forcing water into the pressure chamber of the apparatus at the rate of 1.40 ± 1 cm^3/s. The machine shall be fitted with a Bourdon gage maximum-reading type, with a scale divided to read 2 N. Accuracy shall be within 2 N on readings from 0 to 180 N and to 1.0 percent on any reading over 180 N. When the gage is calibrated it shall be mounted in the same relative position as on the bursting tester.

NOTE — Any machine that operates on the same principal and has coaxial apparatus of 31.2 ± 0.5 mm diameter in the clamping surfaces may also be used.

E-3 TEST SPECIMEN

The test specimen cut from the laminated woven fabric shall be of such size that the smallest dimension is at least 12.5 mm greater than the outside diameter of the ring clamp mechanism of the testing machine.

E-4 PROCEDURE

Before clamping the specimen into the testing machine, bring the water level up flush with the top of the rubber gasket so that no air pocket may exist between the water surface and the laminated fabric being tested. Unless otherwise specified in the case of materials laminated on one side only, place the laminated side next to the water level. In the case of double laminated fabric or double-texture fabrics, either surface may be used unless the side to be put facing downward against the water level is definitely specified. The temperature of the water shall be the same as the atmospheric temperature of the testing room. Conduct the test in accordance with one of the following two procedures, except that when the screen and glass support is employed only Procedure 2 given in **E-4.2** shall be used.

E-4.1 Procedure 1

Increase the pressure steadily at a uniform rate of 1.64 ± 0.07 cm^3/s and take a trial reading at the first appearance of water through the laminated fabric being tested. Make ten different determinations and take their average as the hydrostatic resistance of the laminated fabric. Discard an isolated high or low result that is not repeated in duplicate when a consistent average has been obtained without the abnormal reading and substitute a retest.

E-4.2 Procedure 2

Apply a specified pressure held constant within 14 kPa against the test specimen for a period of 5 min. Any appearance of water through the coated fabric that can be detected during that period will indicate failure to meet the test. Test at least ten specimens from any sample of material. The laminated woven fabric shall be considered to meet the required test if at least eight out of ten tests show no leakage at the pressure specified.

E-5 TEST REPORT

The test report shall indicate the following information:

a) The test method and procedure used and whether or not the screen and glass support was employed.
b) With Procedure 1given in **E-4.1**, all observed and recorded data together with the average value of the hydrostatic resistance, in kPa.
c) With Procedure 2 given in **E-4.2**, the number of specimens tested, the specified pressure applied, and the number of specimens that withstood the pressure.

ANNEX F

(Foreword)

COMMITTEE COMPOSITION

Textile Materials Made from Polyolefins Sectional Committee, TXD 23

Organization	*Representative(s)*
Indian Institute of Packaging, Mumbai	Prof N. C. Saha ***(Chairman)*** Shri H. R. Iyer (*Alternate*)
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